POROUS FUNCTIONAL POLYMERS AS SEPARATORS FOR LITHIUM ION BATTERIES

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The separator is a critical component of a battery. It provides a barrier between the anode and the cathode while enabling the exchange of ionic charge carriers from one side to the other. Separators currently used in Li-ion batteries are made of polyolefins-either polyethylene or polypropylene. They are rendered porous by a mechanical biaxial extrusion process. However, with increasing tendency to pack a lot of energy into a small cell, a safer alternative separator material is needed if devices powered by Li-ion batteries do not become a grenade.

As the battery heats up, the protective layer on the anode breaks down, followed by breakdown of electrolytes into flammable gases. This in turn causes the polyolefin separators to undergo catastrophic shrinkages above 120° C leading to shorting of cells causing sparks that ignite the electrolyte, resulting in a fire. The inherent safety risks threatens the continued advances of Li ion battery into applications requiring higher and higher energy density, such as in smart phones and electric vehicles.

This lecture will address this issue from the point of view of alternative, more safer porous functional polymer materials for separators. A new class of high glass temperature amorphous and porous heterocyclic polymer based separator will be described whose properties appear attractive . We will address strategies used to create porosity, examine mobility of lithium ions across such porous membranes and understand the potential of such materials in this application. Li-sulfur battery is another class of charge storage system which has distinct superiority over Li ion batteries in terms of both energy density and safety. However, Li-S batteries will require entirely new class of separator materials with unique functionalities. Some early results in understanding the structure – function relationship in porous polymer based separators for Li-S batteries will also be presented.